A GLOBAL INVERSE APPROACH TO ICE MASS VARIATIONS AND EARTH RHEOLOGY

Xiaoping Wu, Erik R. Ivins and James L. Fastook
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We study present-day surface mass trends, global ice history, and the earth rheology profile using a global and simultaneous inverse approach.
A nonlinear global inverse algorithm is being developed at JPL for parallel operations on massively clustered supercomputers.
The simultaneous inversion for all relevant parameters will not only yield optimal estimates, but also enable a statistical evaluation of the resolution and uncertainties.
Our covariance and simulation analyses indicate that GRACE gravity and altimeter/GPS elevation rate measurements can distinguish between signatures of present-day surface mass change and viscoelastic rebound. For example, the mean Antarctic present-day ice mass balance can be determined to about 4 mm/yr, corresponding to an error of 0.1 mm/yr in the Antarctic contribution to sea-level change. However, the geodetically determined rebound signatures cannot be used alone to distinguish between the Earth rheology and ice load history. A further combination of secular gravity/elevation data and historical relative sea-level (RSL) records should be used to facilitate an improved parameter separation and to enhance spatio-temporal resolving power.
By comparing and combining the inversion results with the University of Maine dynamic ice evolution model, we also seek to validate both the inversion and the model, to bridge data gaps in time and space, and to understand the mechanisms of cryogenic change and its relationship with climate.
The significance of the new satellite data and the global simultaneous solution, the enormous challenges of inverse modeling the high volume/precision multiple data sets, and research/development progress will be discussed in this presentation.